# BIOECOLOGY AND CONTROL OF BEAN WEEVIL (*ACANTHOSCELIDES OBTECTUS* SAY.)

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***ABSTRACT*** *- The paper presents the results of experimental studies on the evolution of bean weevil (Acanthoscelides obtectus Say. (Coleoptera – Bruchidae) and the duration of development stages in this species, according to air temperature, rainfall and phenological phases of beans varieties Magna, Star and Avans, during 6 years (1994-1999), at the Agricultural Research Station of Podu-Iloaiei, Iaşi County. The pest developed a field generation and 2-3 generations in storehouses, after beans harvesting. It infested bean crops during floral button formation. Egg laying period coincided with grain formation in pods. The bean weevil was controlled by fumigation in storehouses and by tested and homologated insecticides in the field.*

**Key words**: bean weevil, bioecology, development stage, control

## INTRODUCTION

Investigations on bean weevil (*Acanthoscelides obtectus* Say. (Coleoptera – Bruchidae)), in Romania focused on systematics[**] (Panin, 1951); biology, ecology and control (Comes, Borbîrnac, 1951; Săpunaru, Pricop, 1997; Săvescu, 1961; Manolache, 1970; Beratlief, 1978), on problems of prognosis and warning (Săvescu, 1978; Iacob, 1980) and on entomophagues in this species (Filipescu, 1972[***]; Voicu *et al.,* 1992). The results on spreading and damages caused by this species in different localities from Romania, during 1987-1999, have been

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** **Bild Yvonne–Cecilie, 2003**–*Contribution on systemic, morphological and biological study on main pests from peas and beans crops from Moldavia and their control.* Ph.D. Thesis. University of Agricultural Sciences and Veterinary Medicine of Iaşi

*** **Filipescu C, 1972**–*Contribution on systemic, morphological, biological and economic study of Braconidae (Hymenoptera), parasites of the pests harmful to agriculture.* Ph.D. Thesis, „Al. I. Cuza"University of Iaşi.

published by the team conducted by T. Săpunaru in the journal "Cercetări Agronomice în Moldova".

## MATERIALS AND METHODS

We have investigated the evolution of bean weevil for 6 years (during 1994-1999) in the fields of the Laboratory for Plant Protection from the Agricultural Research Station of Podu-Iloaiei, Iaşi County. Observations were conducted on bean varieties Magna, Star and Avans, the duration of development stages (adult, egg, larva and pupa) being established, according to sum of necessary effective temperatures for each stage. We have established the duration of the evolutive cycle for a generation. The evolution of the attack caused by bean weevil (*Acanthoscelides obtectus* Say) was investigated in six districts from Moldavia (Bacău, Botoşani, Iaşi, Vaslui and Suceava).

## RESULTS AND DISCUSSION

**1. Evolution of *Acanthoscelides obtectus* Say.**

In 1994, the hibernating adults appeared in bean crops and nourished between 10 June and 28 July; duration of egg-laying time was between 5 July and 30 July; appearance of larvae and duration of their attack took place between 15 July and 22 July; transformation into pupa and duration of this stage was between 17 August and 10 September. New adults appeared during 1 September – 25 September (*Table 1*).

In 1995, the hibernating adults appeared and nourished between 1 June and 15 June; duration of egg-laying time was comprised between 7 July and 20 July; appearance of larvae and duration of their attack took place between 16 July and 10 August; transformation into pupa and duration of this stage was between 5 August and 28 August. New adults appeared during 1 August– 10 August (*Table 1*).

In 1996, the hibernating adults appeared and nourished between 10 June and 5 July; duration of egg-laying time was between 10 July and 18 July; appearance of larvae and duration of their attack took place between 10 July and 5 August; transformation into pupa and duration of this stage was between 1 August and 22 August. New adults appeared during 17 August– 1 September (*Table 1*).

From data obtained in 1997, the appearance of hibernating adults in crops was noticed between 7 June and 2 July; duration of egg-laying time was between 5 July and 22 July; appearance of larvae and duration of their attack took place between 12 July and 1 August; transformation into pupa and duration of this stage was between 17 August and 5 September. New adults appeared during 22 August– 10 September in storehouses (*Table 1*).

**Table 1**

**Evolution of climatic factors, phenological stages of some bean varieties and biological cycle of bean weevil (*Acanthoscelides obtectus* Say) at the Agricultural Research Station of Podu-Iloaiei, 1994 – 1999**

| Specification | April | | | May | | | June | | | July | | | August | | | September | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| **1994** | | | | | | | | | | | | | | | | | | |
| Temp. air (°C) | 20.2 | 12.9 | 14.0 | 12.5 | 20.0 | 18.9 | 18.7 | 18.3 | 22.1 | 22.4 | 23.3 | 23.5 | 25.3 | 20.8 | 19.1 | 21.4 | 21.0 | 18.5 |
| Rainfall (mm) | 13.0 | 4.7 | 0.2 | 1.7 | 0.3 | 10.1 | 78.5 | 4.0 | 0.3 | 17.1 | 12.4 | - | - | 30.5 | 30.5 | - | 0.3 | 1.7 |
| Phenological phases of varieties Magna, Star, Avans | Sowing: 28 April – 5 May; Emergence: 10 – 17 May; Flowering: 15 June - 5 July; Pod formation: 21 June - 10 July; Maturity: 1 - 5 August | | | | | | | | | | | | | | | | | |
| Biological cycle (Acanthoscelides obtectus) | Hibernating adults in bean crops: 10 June-28 July; Egg-laying : 5.-30 July; Larvae: 15.-22 July; Pupa: 17 August-10 September; Adults: 1-25 September | | | | | | | | | | | | | | | | | |
| **1995** | | | | | | | | | | | | | | | | | | |
| Temp. air (°C) | 7.8 | 8.6 | 14.9 | 11.4 | 14.4 | 18.2 | 21.7 | 22.1 | 19.4 | 22.8 | 30.0 | 23.1 | 21.4 | 22.0 | 20.4 | 17.0 | 16.1 | 13.1 |
| Rainfall (mm) | 7.0 | 7.5 | 6.1 | 30.1 | 34.1 | 21.6 | - | 9.7 | 48.3 | - | 33.0 | - | 3.5 | - | 71.2 | 59.5 | 0.7 | 43.9 |
| Phenological phases of varieties Ami, Star Magna, | Sowing: 6 - 10 May; Emergence: 15 - 20 May; Flowering: 5 June - 1 July; Pod formation: 12 June - 10 July; Maturity: 18 - 25 July | | | | | | | | | | | | | | | | | |
| Biological cycle (Acanthoscelides obtectus) | Hibernating adults in bean crops: 1 - 15 July; Egg-laying: 7 - 20 July; Larvae: 16 July - 10 August; Pupa: 5 - 28 August; New adults: 20 August - 10 September | | | | | | | | | | | | | | | | | |
| **1996** | | | | | | | | | | | | | | | | | | |
| Temp. air (°C) | 6.9 | 6.4 | 16.0 | 19.4 | 21.5 | 18.5 | 22.4 | 20.6 | 21.8 | 23.1 | 18.7 | 20.3 | 21.3 | 19.6 | 18.3 | 15.3 | 12.0 | 10.5 |
| Rainfall (mm) | 3.3 | 45.9 | 0.6 | 3.8 | 14.3 | 6.1 | - | 3.4 | 78.2 | 50.9 | 9.8 | 8.3 | - | 57.2 | 8.9 | 112.9 | 14.8 | 80.5 |
| Phenological phases of varieties Ami, Star, Galbenă de Moldova | Sowing: 10 - 15 May; Emergence: 16 – 22 May; Flowering: 15 June - 10 July; Pod formation: 20 June - 15 July; Maturity: 1 - 10 August | | | | | | | | | | | | | | | | | |
| Biological cycle (Acanthoscelides obtectus) | Hibernating adults in bean crops: 10 June - 5 July; Egg-laying: 1 - 18 July; Larvae in grains: 10 July - 5 August; Pupa: 1 - 22 August; New adults in storehouses: 17 August - 1 September | | | | | | | | | | | | | | | | | |

**Table 1 – continuation**

| Specification | April | | | May | | | June | | | July | | | August | | | September | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III | I | II | III |
| **1997** | | | | | | | | | | | | | | | | | | |
| Temp. air (°C) | 6.0 | 6.2 | 9.1 | 18.0 | 21.3 | 14.9 | 18.6 | 21.2 | 21.2 | 22.7 | 19.8 | 21.4 | 21.7 | 20.4 | 18.3 | 16.3 | 13.5 | 10.6 |
| Rainfall (mm) | 2.5 | 26.3 | 62.7 | 4.1 | - | 21.0 | 6.6 | 34.8 | 28.5 | 27.2 | 10.4 | 27.1 | 6.7 | 0.2 | 92.3 | 12.9 | 11.9 | 12.4 |
| Phenological phases of varieties Ami, Star, Galbenă de Moldova | Sowing: 2 - 8 May; Emergence: 10 - 25 May; Flowering: 23 June - 10 July; Pod formation: 29 June - 15 July; Maturity: 20 - 27 August | | | | | | | | | | | | | | | | | |
| Biological cycle (Acanthoscelides obtectus) | Hibernating adults in bean crops: 7 June - 2 July; Egg-laying: 5 - 22 July; Larvae in grains: 12 July -1 August; Pupa: 17August - 5 September; New adults in storehouses: 22 August - 10 September | | | | | | | | | | | | | | | | | |
| **1998** | | | | | | | | | | | | | | | | | | |
| Temp. air (°C) | 15.2 | 12.6 | 12.4 | 16.11 | 15.0 | 16.1 | 22.3 | 20.1 | 21.4 | 18.8 | 21.0 | 27.5 | 24.2 | 21.1 | 17.0 | 14.6 | 16.2 | 15.5 |
| Rainfall (mm) | - | 49.4 | 6.3 | 3.8 | 33.8 | 14.1 | 9.4 | 81.9 | 1.6 | 50.5 | 38.1 | 14.2 | 4.9 | 0.3 | 28.2 | - | 59.3 | 1.3 |
| Phenological phases of variety Galbenă de Moldova | Sowing: 10 - 18 May; Emergence: 17 - 25 May; Flowering: 18 June - 15 July; Pod formation: 24 June - 10 July; Maturity: 25 July - 1 August | | | | | | | | | | | | | | | | | |
| Biological cycle (Acanthoscelides obtectus) | Hibernating adults in bean crops: 10 June - 7 July; Egg-laying: 5 - 15 July; Larvae in grains: 10 - 23 July; Pupa: 12 - 25 August; New adults in storehouses: 18 August - 1 September | | | | | | | | | | | | | | | | | |
| **1999** | | | | | | | | | | | | | | | | | | |
| Temp. air (°C) | 11.0 | 12.3 | 12.3 | 12.´ | 14.4 | 18.2 | 22.4 | 24.4 | 20.8 | 25.6 | 22.4 | 23.0 | 22.8 | 22.4 | 18.3 | 16.9 | 15.8 | 18.1 |
| Rainfall (mm) | 17.3 | 33.9 | 20.5 | 2.5 | 20.7 | 1.1 | 2.7 | 12.1 | 65.2 | 4.6 | 13.4 | 66.7 | 26.2 | 24.5 | 9.9 | 21.8 | - | - |
| Phenological phases of variety Galbenă de Moldova | Sowing: 15 - 18 May; Emergence: 22 - 27 May; Flowering: 21 June - 17 July; Pod formation: 27 June - 20 July; Maturity: 20 August | | | | | | | | | | | | | | | | | |
| Biological cycle (Acanthoscelides obtectus) | Hibernating adults in bean crops: 15 June - 10 July; Egg-laying: 12 - 22 July; Larvae in grains: 17 - 24 July; Pupa in stored grains: 15 - 29 August; New adults in stored grains: 23 August - 7 September | | | | | | | | | | | | | | | | | |

In 1998, the appearance of hibernating adults in bean crops was noticed between 10 June and 7 July; duration of egg- laying time was between 5 July and 15 July; appearance of larvae and duration of their activity in grains was between 10 July and 23 August; transformation into pupa and duration of this stage was between 12 August and 25 August. New adults were noticed during 18 August – 1 September in storehouses (*Table 1*).

In 1999, the last year of investigation, the appearance of hibernating adults in bean crops was noticed between 15 June and 20 July; duration of egg-laying time was between 12 July and 22 July; appearance of larvae and their evolution in grains took place between 17 July and 24 July; transformation into pupa and duration of this stage was between 15 August and 29 August. New adults were noticed during 23 August– 7 September in storehouses (*Table 1*).

**2. Duration of development stages in *Acanthoscelides obtectus* Say.**

Daily observations were carried out under field and laboratory conditions concerning incubation period, duration of the evolution of larvae stages, pupa duration, and longevity of new adults. The duration of egg-laying stage was between 8 and 10 days (1994), 9 – 12 days (1995), 9 – 17 days (1996), 8 – 12 days (1997), 9 – 15 days (1998) and 9 – 16 days (1999). The evolution of larva stage was comprised between 21 and 32 days (1994), 19 – 20 days (1995), 17 – 20 days (1996), 18 – 20 days (1997), 21 – 23 days (1998) and 19 – 23 days (1999). The pupa stage was between 13 – 15 days (1994), 13 – 15 days (1995), 10 – 16 days (1996), 12 – 16 days (1997), 11 – 13 days (1998) and 13 – 15 days (1999).

The period of new adults development was between 16 – 25 days (1994), 15 – 20 days (1995), 13 – 15 days (1996), 16 – 18 days (1997), 13 – 15 days (1998) and 13 – 15 days (1999) (*Table 2*).

The evolution cycle of species *Acanthoscelides obtectus* Say. was comprised between 58 and 72 days (1994), 54 – 74 days (1995), 49 – 68 days (1996), 53 – 66 days (1997), 54 – 61 days (1998) and 54 – 69 days (1999) (*Table 2*).

All these differences have been caused by the influence of abiotic factors, which acted on the population of bean weevil, under conditions of the Agricultural Research Station of Podu-Iloaiei , Iaşi County.

The analysis of data from *Table 3* found out that the bean pest was signalled in all bean crops from Moldavia, during 1987-1999, causing great damages during the grain storing.

**Table 2**

**Duration of development stages in *Acanthoscelides obtectus* Say. at the Agricultural Research Station of Podu-Iloaiei, Iaşi County (1994 – 1999)**

| Specification | Days (no.) | | | | | |
|---|---|---|---|---|---|---|
| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
| Incubation period, egg-laying time | 8-10 | 9-19 | 9-17 | 8-12 | 9-15 | 9-16 |
| Larvae | 21-32 | 19-20 | 17-20 | 18-20 | 21-28 | 19-23 |
| Pupa | 13-15 | 13-15 | 10-16 | 12-16 | 11-13 | 13-15 |
| Adults | 16-25 | 15-20 | 13-15 | 16-18 | 13-15 | 13-15 |
| Duration of evolution cycle | 58-72 | 54-74 | 49-68 | 54-66 | 54-61 | 54-69 |

**Table 3**

**Evolution of the attack of bean weevil (*Acanthoscelides obtectus* Say.) in Moldavia (1987 – 1999)**

| Year | Damaged grains (F%) | | | | | |
|---|---|---|---|---|---|---|
| | Bacău | Botoşani | Iaşi | Neamț | Vaslui | Vrancea |
| 1987 | 0.03-0.2 | 0.1-0.7 | 1.0-1.5 | 1.2-2.1 | 0.2-1.1 | 1.5-3.0 |
| 1988 | 0.05-0.5 | 0.1-0.9 | 0.1-2.0 | 0.3-1.5 | 0.1-0.6 | 0.6-1.2 |
| 1989 | 0.1-0.8 | 0.5-2.0 | 0.5-2.3 | 0.6-2.7 | 0.2-1.3 | 0.1-1.8 |
| 1990 | 0.2-0.9 | 0.2-1.0 | 1.1-1.5 | 0.1-1.1 | 0.1-1.1 | 0.1-1.2 |
| 1991 | 0.1-0.7 | 0.3-1.0 | 0.1-2.1 | 0.2-0.8 | 0.3-0.9 | 0.1-1.5 |
| 1992 | 0.1-0.5 | 0.1-0.5 | 0.2-1.3 | 0.01-0.5 | 0.1-0.7 | 0.1-1.2 |
| 1993 | 0.1-0.7 | 0.1-2.1 | 0.1-2.3 | 0.3-2.0 | 0.5-2.8 | 0.4-1.5 |
| 1994 | 0.1-2.1 | 0.3-2.8 | 0.3-3.5 | 0.1-2.9 | 0.3-2.9 | 0.3-2.9 |
| 1995 | 0.1-1.3 | 0.1-0.7 | 0.2-1.6 | 0.1-0.8 | 0.1-1.2 | 0.3-1.3 |
| 1996 | 0.05-0.4 | 0.1-0.5 | 0.1-1.0 | 0.1-0.6 | 0.8-0.9 | 0.1-1.1 |
| 1997 | 0.1-0.2 | 0.1-0.3 | 0.1-0.7 | 0.1-0.3 | 0.3-0.8 | 0.1-0.9 |
| 1998 | 0.1-0.2 | 0.1-0.2 | 0.1-1.2 | 0.1-0.2 | 0.1-0.5 | 0.1-0.5 |
| 1999 | 0.1-0.4 | 0.1-0.5 | 0.1-2.0 | 0.1-0.3 | 0.1-1.0 | 0.2-1.5 |

**Damaged plants and way of damaging.** Bean weevil (*Acanthoscelides obtectus* Say.) has affected all been varieties, the most affected ones being Phaseolus *multiflorum*. Sometimes, chickpea and soybean were also attacked. Larvae caused damages, by eating the inner side of grains. According to their size, 1-26 larvae could develop into grains. Grains became useless for consumption and sowing (Manolache *et al.,* 1966).

**Control.** We recommend that beans should be harvested in time and without losses. Grain must be stocked at moisture of 12%, in well-closed places, disinfected with solutions Carbetox 37 CE. Nogos 50 CE or thermal aerosols with Diclorvos or pirimifosetil.

The infested crop must be fumigated with carbonate sulphur (100 – 200g / 100 Kg grains or 200 – 350 g/$m^3$, with a display period of 24 – 48 hours and a temperature below $12^0$C), methyl bromide (24 – 30 g/$m^3$) with a display period of 24 hours; phosphorate hydrogen (Phostoxin). Delicia (Gastoxin) or Ultraphos tablets (5 – 15 g/t) with a display period of 3 – 5 days, under tarpaulin. The bean grains must be stored in bulk and sacks.

We also recommend the cultivation of early varieties. New crops should be placed at a higher distance than 3 km to the old crops or storehouses. Only healthy seeds or treated by fumigation with contact insecticides (FB – 7, Sinoratox 3 pp, Tirametox 90 PTS (2-3 Kg / t) should be used.

In the highly infested areas, chemical treatments should be applied during flowering, with organo-phosphoric products: Sinoratox 35 CE, Diazol 50 CE (1.5-2 l/ha) or synthetic piretroids: Ciperthrin 10 CE (0.1 l/ha), Decis 5 CE (0.2 l/ha) or Fastac 10 CE (0.150 l/ha). etc.

In case of strong invasions, two treatments may be applied: the first treatment - at the beginning of flowering and the second - after 8-12 days, all the conditions for the protection of fauna and humans being fulfilled.

## CONCLUSIONS

Under conditions of the Agricultural Research Station of Podu-Iloaiei, Iaşi County, and in the entire country, *Acanthoscelides obtectus* Say. (bean weevil) develops a field generation and 2-3 generations in storehouses, where it finds a proper temperature for its development. It hibernates at the adult stage in shivered grains, which remain in the field after harvesting and in stored grains (90%).

In a bean grain, 1-28 larvae develop, eating the entire grain content. The pest attacks all bean varieties and infests bean crops during the stage of floral button formation. Egg- laying time coincides with pod formation.

For controlling the bean weevil from storehouses, we recommend the fumigation with Phostoxin. Delicia (Gastoxin) or Ultraphos 5 – 15g / t of beans, with a display period of 3-5 days. In the field, we recommend treatments during flowering period with organo-phosphoric products (Sinoratox 35 CE., Diazol 50 CE – 1.5 – 2 l/ha) or with piretroids (Ciperthrin 10 CE – 0.1 l/ha, Decis 5 CE - 0.2 l/ha, or Fastac 10 CE - 0.150 l/ha, etc.).

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